5-Year Business Plan for

Jefferson Lab

DRAFT

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I. Overview

Built, managed and operated by the Southeastern University Research Association (SURA) for DOE's Office of Science, Jefferson Lab – the Thomas Jefferson National Accelerator Facility, located in Newport News Virginia – operates a worldwide unique research instrument (CEBAF) for an international user community of over 2000 researchers. The annual operating budget is approximately $100 million including non-DOE sources, and the Lab employs approximately 600 full-time physicists, engineers, technicians, and support staff. Construction of the facility was completed in 1995; research operations (started at full capacity in 1997) have produced scientific data for 110 experiments to date, including the thesis material for about one-fourth of all US PhDs awarded annually in Nuclear Physics.

Jefferson Lab's Business Plan postulates *Initiatives* that logically continue and extend present *Business Lines;* both are solidly anchored in existing *Core Competencies.* JLab is a world leader in all its *Business Lines* and the present plan intends to advance and consolidate this leadership position.

Central to the JLab mission is the *Business Line* of Nuclear Physics – experimental, theoretical, and computational – with the *Initiatives* of the 12 GeV Upgrade, the Lattice Quantum Chromodynamics (LQCD) high performance computing effort, and the Excited Baryon Analysis Center.

To design, build, and successfully operate the Continuous Electron Beam Accelerator Facility (CEBAF), JLab developed and significantly advanced the *Core Competency* of srf technology. As a partner lab, JLab brought this essential competency to bear in the construction of the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory (ORNL). The steady advancement of srf technology at Jefferson Lab underlies the 12 GeV Upgrade of CEBAF, and is at the center of JLab's *Initiative* to become a key player in the ILC.

An application of this srf core competency is the DOD funded work to build, operate, and further advance high power Free Electron Lasers (FELs). JLab operates as a current *Business Line* the world's highest power FEL. *Initiatives* continuing this line aim at extending power levels to one MegaWatt (MW) for defense use, to extend the spectral range to include the ultra-violet, and exploit the unique features of the FEL to make discoveries in biomedical science, chemistry, and physics.

Jefferson Lab champions efforts to stimulate interest in science and technology among youth by providing an educational pipeline essential for training and developing tomorrow's scientists. The Lab's science education programs touch K-12 students, teachers in training and in the classroom, undergraduate and graduate students. The Becoming Enthusiastic About Math and Science (BEAMS) program, unique to Jefferson Lab, enhances academic performance of at-risk middle school students in science and math and serves as a national model.

SURA, JLab's M&O Contractor, provides the benefits of close association with academic institutions: professorships as enticement for the hire of exceptional staff, the involvement and active interest of researchers based in academe, and the relations building skills of the Presidents of SURA's sixty-seven member Universities. Looking forward, SURA is partnering with an industrial entity to assist in JLab's effort to optimize its organization and work processes.

II. JLab Mission

It is JLab's mission:

1) To lead an international, academic and national lab based user community in the exploration of strong QCD to elucidate the quark-gluon structure of nucleons and nuclei, through exemplary

operation of a worldwide unequalled research facility, and theoretical, phenomenological, and computational support

2) To enable the education of a significant percentage of new PhDs in nuclear physics

3) To advance, maintain, and consolidate US leadership in the technology of radiofrequency (rf) superconductivity

4) To advance photon science and technology on the basis of high power FELs ranging from the deep ultraviolet (DUV) to the Terahertz (THz) region

III. Major Business Lines – A. Nuclear Physics (6 GeV Research)

Jefferson Lab's core business line is basic research into the nature of hadronic matter. We operate a world-wide unique nuclear physics user facility for scientific research using continuous beams of high-energy electrons and state-of-the-art instrumentation to elucidate the complex dynamics by which quarks, interacting via gluons, form the stable matter of everyday experience.

Nuclear science is a key component of the nation's research portfolio, providing fundamental insights into the nature of matter and nurturing applications critical to the nation's health, security, and economic vitality. It continues to have significant impact on other fields of basic research (ranging from astrophysics to biology and medicine) through a combination of new knowledge on the structure of matter and "spin-off" technologies. Technology "spin-off" from Jefferson Lab research includes advanced detectors useful for medical imaging and homeland security and superconducting radiofrequency (SRF) systems with applications ranging from national defense to next generation light sources and the International Linear Collider.

The field is also an important source of our technological work force. More than half of nuclear science PhDs apply their training outside their field — notably, in medicine, industry, and national defense. Jefferson Lab is a major contributor; fully one-quarter of US PhDs in nuclear science are based on Jefferson Lab science (192 PhDs to date, and 153 more in progress).

Full research operations using the CEBAF electron accelerator have been underway since late 1997. This program has been remarkably productive, with more than 147 Physics Letters and Physical Review Letters published to date and 322 publications in other refereed journals. Collectively, they have had over 10,000 citations in the scientific literature. Our nuclear physics experimental program can be organized into three major research themes addressing key scientific questions of paramount importance for our understanding of nuclear physics. These themes coincide with the broad directions of the field as identified in two key documents: the 2002 Nuclear Science Advisory Committee (NSAC) Long Range Plan[1] and the recent decadal survey of the field by the NAS/NRC[2]. We identify these questions here to place our research program in this broader context. Together these research thrusts address 8 of the 10 milestones set by the OMB Performance Assessment Rating Tool (PART) for hadronic physics. The themes are:

1) On the Structure of the Nuclear Building Blocks:
   a) How are the nucleons made from quarks and gluons? — a program of measurements addressing this question must be answered in the quest to understand nuclear physics in

[1] "Opportunities in Nuclear Science: A Long-Range Plan for the Next Decade", a report by the DOE/NSF Nuclear Science Advisory Committee, April, 2002.
[2] *Nuclear Physics: The Core of Matter, The Fuel of Stars*, The Committee on Nuclear Physics of the Board on Physics and Astronomy of the Commission on Physical Sciences, Mathematics, and Applications of the National Research Council, National Academy Press, Washington, D.C. (1999).

terms of the fundamental theory of strongly interacting matter: quantum chromodynamics (QCD). This begins with the QCD vacuum and how it is modified by the insertion of hadronic matter.

b) How does QCD work in the '"strong" (confinement) regime? — experiments and theory aimed at examining the fundamentally new dynamics that underpin all of nuclear physics: the confinement of quarks.

c) How does the nucleon-nucleon (NN) force arise from the underlying quark and gluon structure of hadronic matter? — a broad program of experimental and theoretical work focused on moving beyond current phenomenological descriptions of the NN force (for example, to determine its basic nature as a mixture of meson exchange, quark exchange, and color polarization effects).

2) On the Structure of Nuclei:

a) What is the Structure of Nuclear Matter? — a carefully focused experimental program taking advantage of the precision, spatial resolution, and interpretability of electromagnetic interactions to address fundamental issues in nuclear physics with the aim of developing a more profound understanding of nuclear structure which can be applied in unexplored regimes.

b) At What Distance and Energy Scale Does the Underlying Quark and Gluon Structure of Nuclear Matter Become Evident? — a combination of experimental and theoretical work now being carried out at Jefferson Lab and in the community at large focusing on few-body systems where directly interpretable experiments can be compared with exact calculations that are now feasible in the context of ab initio calculations of nuclear properties.

3) Symmetry Tests in Nuclear Physics

Is the "Standard Model" complete? What are the values of its free parameters?
The Standard Model has been highly successful in describing phenomena in nuclear and particle physics. Traditional tests have been performed at the Z pole and through high-energy searches for new particles. JLab has launched a program aimed at testing the theory and determining its constants in both the electro-weak and strong sectors using an alternate approach – precision measurements at low energies. Precision tests of this kind give one access to new physics at the trillion electron volts (TeV) scale, beyond the reach of current high energy accelerators.

As is typical for a facility like CEBAF, this research program covers a broad range of the "risk" spectrum. About three-quarters of the experiments involve well-understood (but often technically demanding) measurements that will provide information known to be needed to advance the field. About one-quarter are relatively higher risk in that they involve speculative studies at the limits of our current understanding. Of course it is not unusual that surprises in the results of presumed lower risk measurements open new windows in our quest to understand strongly interacting matter.

CEBAF currently has a backlog of about forty experiments. For operations at our FY05 funding levels, this backlog is close to an optimum balance between the planning and construction necessary for experiments of typical complexity and the flexibility necessary to respond to new ideas and opportunities. Each of these experiments[3] represents superb physics that has been reviewed and recommended with high scientific rating by our Program Advisory Committee; they are all in various stages of preparation. Executing this program with funding at the FY05 level would take about four years, and permit analysis and interpretation of the data to be completed in a timely manner. The

[3] Details about the experiments that make up this program are available on our website at: http://www.jlab.org/div_dept/physics_division/experiments/

additional experiments that will complete the fifth year of the program will be defined over the next year with the help of our Program Advisory Committee.

A large fraction of the planned program is focused on addressing the scientific issues motivating the OMB PART "milestones" for Hadronic Physics; these are identified with the phrase "OMB milestone" following the subject in Table 1 below. Completing this portion of the program is essential if we are to gather the data required to achieve these milestones. A substantial fraction of these experiments build on the successes of the recent past, completing a program of measurements that has been underway for years. A number of the experiments planned (such as the measurement of the neutron radius in Lead 208 (^{208}Pb) have an impact in more than one of these areas and their placement is somewhat arbitrary. In addition, there are many important experiments planned for the next five years that are not directly connected to the OMB milestones. These are summarized in Table 2 below and, again, further details are available on the Jefferson Lab web site[3].

To summarize this program by research theme, its main thrusts include:

The Structure of the Nuclear Building Blocks

- Measure precisely the nucleon's charge and magnetization distribution and determine its decomposition into the contributions from the different quark flavors (OMB milestone)
- Determine the degrees-of-freedom governing the nucleon's excitation spectra and reveal the structure of these excitations by measuring their transition form factors (OMB milestone)
- Determine the internal structure of the nucleon in the valence region via measurements of the lowest moments of their unpolarized structure functions (OMB milestone)
- Develop the experimental and theoretical tools necessary to carry out a program of nucleon tomography (OMB milestone). Recent astonishing results from two JLab experiments (G0 and HAPPEx) suggest as much as 60% of the isoscalar magnetic moment may come from strange quarks, must be pursued vigorously.

The Structure of Nuclei

- Probe the nuclear interior with a controlled impurity to learn about deeply-lying shell structure and to help unravel the QCD basis for the N-N force
- Clarify the short-range component of the nucleon-nucleon interaction in nuclei and compare the properties of bound nucleons with those of free nucleons (OMB milestone)
- Measure the neutron radius of ^{208}Pb to provide vitally needed information for physics ranging from nuclei far from stability to the modeling of neutron stars and the interpretation of atomic parity violation experiments. This knowledge may prove relevant to compatibilities within the context of stockpile stewardship.
- Extend our knowledge of the elastic form factors of light nuclei to momentum transfers where the underlying quark-gluon structure of the nucleus may become evident.

Symmetry Tests in Nuclear Physics

- Determine the weak charge of the proton to test the Standard Model predictions for the "running" of the electroweak coupling constant and to begin an important search for TeV scale physics beyond the Standard Model

The next essential step forward for this decade is the realization of the 12 GeV Upgrade; it is motivated by outstanding science and has been endorsed by the community through the NSAC Long Range Planning process. The higher beam energies and enhanced experimental equipment provided by the 12 GeV Upgrade project are essential if we are to revolutionize our picture of the nucleon structure and shape by addressing such fundamental issues as quark confinement – one of the outstanding questions of 21st century physics – and quark correlations in the nucleon. Details are provided in the "Initiatives – A." section of this document.

The Portion of CEBAF's Experimental Research Plan for the Next Five Years Directly Connected to the OMB Milestones for Hadronic Physics

Table 1

Milestone Year	Experiment #	Title	Hall	Run Year
2008	**Analyze DVCS data on GPDs**			
	E01-113	Deeply Virtual Compton Scattering via $e\ p \rightarrow e'\ p\ \gamma$	Hall B	2005/8
2009	**Combined analysis of N* data on single π, η, and K photo-production of N*…**			
	E98-109 / E99-013	Meson Photo-production with Linearly Polarized γ	Hall B	2005
	E02-112 / E03-105 / E05-012	Meson Photo-production with Polarized Beam and Target	Hall B	2006
	E04-005	Hybrid Mesons and Exotic Baryons in Photo-production	Hall B	2006
2010	**Determine the electroweak form factors of the nucleons**			
	E00-114	ρ_s via Parity Violating e-Scattering off ^4He at Low Q^2	Hall A	2005
	E99-115	Parity Violating e-Scattering off the Proton at Low Q^2	Hall A	2006
	E02-013	Measurement of the Neutron Electric Form Factor G_e^n	Hall A	2006
	E04-115	Parity Violation in Backward e-Scattering off the Proton	Hall C	2006
	E04-108	Proton Form Factor G_e/G^m via Recoil Polarization	Hall C	2007
	E04-019	Two-Photon Exchange in e-p Scattering via Recoil Polarization	Hall C	2008
	E04-116	Search for 2γ Contributions to ep Scattering	Hall B	2008
	E05-017	2γ-Exchange in e-p Scattering via Rosenbluth Separation	Hall C	2008
2010	**Characterize nucleon correlations and free vs bound nucleon properties**			
	E01-015	Internal Small-Distance Structure of Nuclei via $^{12}C(e,e'NN)$	Hall A	2005
	E03-104	Probing Nucleon Medium Modifications via $^4He(e, e'\ p)^3H$	Hall A	2007
2011	**The lowest moments of the unpolarized nucleon structure functions**			
	E03-012	Neutron Structure Function via Tagging of p_s in $D(e,e'p_s)X$	Hall B	2005
	E02-109 / E04-001	$R = \sigma_L/\sigma_T$ on Deuterium in the Resonance Region	Hall C	2008
	E03-109	Spin Asymmetries of the Nucleon via $e\ p \rightarrow e'\ X$	Hall C	2009
2012	**Measure the EM excitations of low-lying baryon states (M <2 GeV) and their transition form factors**			
		Data for electro-excitation taken. Photo-production data still needed (see 2009 Milestone). Analysis (and EBAC) will be a major effort		

Experiments now planned for the next five years that are not directly relevant to one of the formal milestones for hadronic physics.

Table 2

Experiment #	Title	Hall	Run Year
E94-107	Electromagnetic Production of Hypernuclei	Hall A	2005
E01-011	Electromagnetic Production of Hypernuclei via $A(e,e'K^+)$	Hall C	2005
E03-006	Low Q^2 GDH Integral for the Proton	Hall B	2006
E04-018	Form Factors of ^{3}He and ^{4}He from Elastic Electron Scattering	Hall A	2007
E03-101	Hard Photodisintegration of a Proton-Proton Pair	Hall A	2007
E03-004	Transversity in Semi-Inclusive Pion Electroproduction off ^{3}He	Hall A	2008
E02-108	Asymmetry in Quasi-Elastic ^{3}He(e,e'd)p	Hall A	2008
E05-015	Single Spin Asymmetry off Polarized ^{3}He	Hall A	2008
E02-104 / 02-110	Quark Propagation / Nuclear Transparency	Hall B	2008
E03-011	Neutron Skin of ^{208}Pb through Parity Violating Electron Scattering	Hall A	2009
E05-007	Deep-Inelastic Parity Violating Electron Scattering	Hall A	2009
E05-009	Penta-quark Search	Hall A	2009
E03-109	Spin Asymmetries of the Nucleon via e p → e' X	Hall C	2009
E04-113	Semi-Inclusive Spin Asymmetries of the Nucleon	Hall C	2009
E05-008	Measurement of the Weak Charge of the Proton, Qweak	Hall C	2010

III. Major Business Lines – A. Nuclear Physics (Theory Center)

Goal: To provide intellectual leadership, guidance and support for the entire research program of the laboratory.

The research program in Theory is exceptionally well matched to the key experimental programs at 6 GeV as well as the anticipated 12 GeV Upgrade. This represents an enormous breadth of science, from fundamental advances in lattice QCD to studies of Generalized Parton Distributions, meson and baryon spectroscopy and tests of perturbative QCD, as well as precise few-body calculations and searches for physics beyond the Standard Model.

In order to provide expert support over such a diversity of topics the Center has chosen to make a number of targeted joint appointments at the nearby universities. The most recent appointments have been at William and Mary, namely, Drs. M. Vanderhaeghen and K. Orginos. The importance of phenomenological support for the experimental program (which experience has shown cannot be provided within the University system) was also emphasized by the appointment of two outstanding young theorists in 2004, Drs. W. Melnitchouk and C. Weiss. Both have already made crucial contributions to the science case for the 12 GeV Upgrade.

A major new initiative associated with the arrival of Dr. A. Thomas as Chief Scientist and Director of the Theory Center was an injection of $150K per annum into the Theory visitor program. The intention is to make Jefferson Laboratory a national and international focus for theoretical hadronic physics. This involvement has already led to our participation as a founding member (along with the Argonne National Lab theory group) of an international network in hadronic physics, including strong groups in Tübingen, Graz and Adelaide, amongst others. The fundamental aim of the work of this network goes to the heart of the Jlab program, the discovery of just how hadrons, nuclei and nuclear matter arise from QCD and whether this is, indeed, the complete theory of the strong force.

III. Major Business Lines – B. SRF and Related Accelerator Physics

Conceiving, designing, prototyping, building, integrating, and operating superconducting accelerating systems are essential core competencies of JLab and thus must constitute an essential JLab business line. They support operation of CEBAF, the world's largest srf accelerator with 332 installed cavities, the prototyping for the 12 GeV Upgrade, the development and operation of the world's highest power FEL, and in support of other Office of Science priorities beyond JLab confines, some prototyping in the context of RIA R&D and most significantly, the construction of the SRF linac for the Spallation Neutron Source at ORNL. These activities were accompanied by a modest amount of true R&D, resulting most recently in the breakthrough development of a large-grain Niobium operating at an accelerating field of 45 MV/m, the world record to date achieved with minimal processing.

JLab is the foremost US center for this technology. A recent benchmarking exercise, comparing the Lab with DESY based on some sixty parameters, concluded that JLab is a world leader at par with DESY.

This technology is central to many recent, proposed, and conceptually discussed accelerators, because it permits the highest gradients in high duty factor operation and makes feasible very large accelerators with otherwise prohibitive power consumption, even without the rapidly developing techniques of Energy Recovery being developed at JLab, mainly due to almost zero energy dissipation in superconducting boundaries with continuous operation. The decision to base an eventual International Linear Collider (ILC) on SRF technology highlights these facts, as do other priorities in SC's 20-Year Facility Outlook, such as RIA, an SNS Upgrade, a new light source, and neutrino beam facilities.

A parallel development, made possible and advantageous by SRF, is the energy-recovering linac, as mentioned earlier and pioneered in JLab's FEL. This approach will enable light sources to transcend conventional limitations on beam intensity, brightness and short pulse length, and make possible very high current linacs for potentially high luminosity future electron-ion colliders.

It is JLab's goal to consolidate a position as the world leader in SRF technology and related accelerator physics, providing a foundation for reducing technical risk and cost of planned and future SRF-based accelerators for the Office of Science. Specifically, JLab plans to be a technology provider of choice for RIA R&D and the ILC, as well as develop aspects relevant to ERL-based light sources and colliders.

In technical terms, JLab plans to make progress along two major "axes": first, advance gradients and Q value simultaneously; second, advance high beam currents. The first line of pursuit is most relevant and most critical to the ILC. For overall cost reduction, rf losses must be reduced as gradients are increased, and reliable, reproducible production processes must be further developed and optimized in the entire development process. JLab has the world's largest production experience – most recently with the SNS – and has achieved recent R&D breakthroughs with its large-grain niobium cavity. JLab investigators believe that gradients as high as 45 MV/m, losses essentially at the fundamental BCS limit of superconductivity in niobium, and simplified production processes -- all can be achieved.

The second line of pursuit will be limited to the scope demanded by the objectives of JLab's Navy - funded FEL program to advance technology toward a one MW level output Free Electron laser, requiring cryomodules capable of supporting continuous electron beam currents of up to an Ampere. DOD currently funds the development of a "One Ampere Cryomodule", eventually leading to the solution of most problems associated with very high current operation of SRF accelerators.

III. Major Business Lines – C. Photon Science and Technology

Jefferson Lab has effectively leveraged work for others – in this case for the Department of Defense (DOD) – to advance SRF technology, develop the concept of the ERL into a practical tool, and to advance the field of photon science and technology. JLab considers its work highly effective in this area – more Free Electron Laser (FEL) progress for nearly $ 60 M than produced in the entire Space Defense Initiative (SDI) program – to be a demonstration of the creativity and productivity of dedicated Lab staff trained in fundamental science and its support disciplines.

Work for the Navy aims at Megawatt (MW) class technology in the wavelength range of 1 to 2 μm, currently demonstrating 10 Kilowatt (kW). Work for the Air Force supports a micromachining effort, for which the Lab currently installs a 1 kW capability in the Ultra Violet. Army interests have funded the design and installation a dedicated beamline and user lab for exploration of kW-class Terahertz (THz) radiation.

A modest effort, funded by miscellaneous non-DOE sources, and most importantly the Commonwealth of Virginia, made a small research program possible that has resulted in noteworthy results in both basic and applied photon science. The Jefferson Lab FEL is an excellent research tool, complementing other light sources. It covers – currently or in the immediate future - the wavelength range from mm to 250 nm, combining unique assets of ultra-fast pulses with broad tunability at unprecedented power levels with continuous/high repetition rate operation.

Work for the DOD will remain central to the FEL effort over the next five years. The total effort is expected to range from $ 15M to $25 M/year over the next five years. Key deliverables to the Navy will be the technology of MW class FELs for shipboard self-defense and related materials and propagation studies Along this path, one or more 100 kW class FELs will be funded by the Navy, including a full or partial upgrade of the installation at JLab and a "palletized" version to be installed at a location of the Navy's choosing.

Many results of this work will be directly relevant to the Office of Science's efforts. The operation associated with this effort will create a substantial and unique knowledge base for the beam dynamics, technology, and operation of high power ERLs, including the creation of a superconducting linac capable of accelerating Ampere level beam currents (an effort begun in FY05).

Specific near term goals include: achieving 10 Kilo Watt (kW) operation in the more challenging short wavelength region (1-2 microns) of the full 1 – 14 micron infrared tuning range, 1 kW operation in the 250 nm – 1 micron range, and 100 Watt operation in the 0.1 – 5 THz range. Additionally, construction of an injector capable of 100 mA at 750 MHz is underway as part of the development of the next generation 100 kW Infrared FEL.

JLab plans to continue its effort to receive additional support for ERL R&D and to exploit the unique capabilities of the FEL for scientific discovery. JLab FEL technology development efforts have provided opportunities to test accelerator source, linac and diagnostic capability which has significantly benefited the lab's NP program. This synergy will continue as ERL technology is being explored for next generation NP devices such as the proposed e-LIC and e-RHIC concepts.

A laser bioscience initiative, tying into local economic development efforts, under the scientific leadership of Massachusetts General Hospital and the Eastern Virginia and University of Virginia Medical Schools, will come to fruition in the 2008 time frame.

Finally, JLab will continue efforts to market its capabilities to DOE Basic Energy Sciences (BES). The FEL can address scientific problems that map directly onto DOE-BES missions, such as those associated with energy conversion, molecular dynamics, chemical pathways, complex systems and hydrogen conversion and storage. In the THz arena, the FEL enables critical and novel AMO dynamics studies using 2 and 3 photon spectroscopy, as documented in the recent BES/NSF/NIH workshop on THz science (Feb.2004).The JLab FEL addresses the BES mission in nanoscience in a novel way, namely length-scales that lie between 1 nanometer and 1 micron, correspond to time-scales from 1 femtosecond to 1 picosecond. The JLab FEL also could advance and refine experiments to determine the electronic quantum structure of complex systems using time-of-flight photoemission to give unprecedented energy and momentum resolution.

IV. Initiatives – A. 12 GeV Upgrade

With the Upgrade of JLab to 12 GeV, the Office of Science will open a panorama of discovery in fundamental nuclear physics.

- Through the search for exotic mesons, in which gluons are an unavoidable part of the structure, we will explore the fascinating and complex vacuum structure of QCD and the nature of confinement.
- Through extremely high precision studies of parity violation, developed in order to study the role of hidden flavors in the nucleon, we can explore physics beyond the standard model, on an energy scale that cannot be explored even with the proposed linear collider.
- The combination of luminosity, duty factor and kinematic reach of this machine will far surpass anything that has previously been available allowing us a hitherto impossible view of the spin and flavor dependence of the valence parton distributions – the heart of the proton, where its quantum numbers are determined.
- We will be able to take a revolutionary look into the structure of atomic nuclei, exploring how the valence quark structure is modified in a dense nuclear medium. These studies will give us a far deeper and more fundamental understanding of the structure of atomic nuclei with far reaching implications for all of nuclear physics as well as nuclear astrophysics.
- The Generalized Parton Distributions will allow us for the first time to engage in nuclear tomography, discovering the true three-dimensional structure of the nucleon.

No other nation is able to carry out such a program of discovery using the amazing precision of the electromagnetic probe. The United States alone carries the torch for these studies which are both central and essential to 21st Century nuclear science.

The project, explained below, has low technical risk and modest cost because of the existence of JLab and the expertise of its staff. There is an excited community world-wide waiting for the opportunity to make these discoveries.

12 GeV Project Description

CEBAF occupies a racetrack-shaped footprint. Each straight section contains a linac made up of 20 cryomodules. To recirculate the beam, magnetic transport channels making up the curved sections, the so-called arcs, connect these linacs. Several factors contribute to make the 12 GeV Upgrade highly cost effective. First, on average, the existing critical components of the accelerator exceed their design specifications by 50% resulting in the capability to run at 6 GeV electron beam energy rather than the originally specified 4 GeV. Second, continued efforts – summarized in the SRF section of this business plan – have led to the development of a new cryomodule type capable of exceeding the original CEBAF specifications by a factor of five. Third, for reasons of project construction history, each linac contains five empty slots with most of the ancillary provisions ready to accept the new high performance cryomodules. Fourth, the radius of the arcs was generously lead out to avoid serious emittance degradation that might have precluded ever achieving higher energies.

In the new experimental Hall D, a tagged coherent bremsstrahlung beam – created using the full 12 GeV beam energy - and solenoid detector will be constructed for a program of gluonic spectroscopy to experimentally test our understanding of quark confinement. Additional experimental equipment proposed for the Upgrade project will optimize the scientific capabilities and takes full advantage of apparatus developed for the present program. All three existing Halls will be able to receive the full 5-pass beam energy. Critical Decision Zero (CD-0) was approved in March 2004. The preliminary estimated DOE Total Project Cost (TPC) range is $182,000,000 to $257,000,000, as established at CD-0 and adjusted for inflation. Approval of Critical Decision One (CD-1) for the 12 GeV Upgrade is anticipated in September 2005. As part of the preparation for the CD-1 decision, the DOE conducted a Review of the Science of the 12 GeV Upgrade in April 2005. The committee concluded that the science capabilities are very compelling and noted two specific areas as having "discovery potential". The next step toward CD-1 will be an Independent Project Review of the cost and schedule in mid-July 2005.

IV. Initiatives – B. Excited Baryon Analysis Center (EBAC)

Success in this initiative will lead to a profound understanding of the spectrum of excited baryons and hence the nature of confinement, including the way excited hadronic matter modifies the nonperturbative QCD vacuum.

Risk: It is an extremely challenging problem for theoretical physics to deal with multi-particle final states in a manner consistent with the constraints of unitarity, crossing and analyticity. One cannot guarantee success but it is clear that success is not possible without serious, sustained theoretical effort at the highest level, in cooperation with those involved in data analysis. This can only be carried out at a national laboratory such as JLab.

The Strategic Plan for Nuclear Science, prepared by the Office of Science, states that connecting the observed properties of baryons with the underlying framework provided by QCD is one of the central challenges of modern science. In order to address these questions it is essential to have a clear understanding of the spectrum of excited states of the nucleon. However, it has become clear over the past few years that the analysis of data for the production of such states at JLab and elsewhere requires a far more coherent and advanced theoretical understanding than had been anticipated.

With this in mind, a proposal to establish an Excited Baryon Analysis Center was submitted to DOE in 2003. In response to suggestions by the referees and following the arrival of Dr. A. Thomas, a revised proposal was submitted late last year. The key idea is to build a network of all relevant theoretical and experimental groups world-wide to agree on a coherent program of data analysis. In parallel with the development of new theoretical tools to deal with the complex, multi-particle final states encountered in this field one would need a team of phenomenologists working with the relevant experimental groups to apply the state of the art theoretical models to their data.

The importance to the field is also recognized by the fact that the analysis of a particular subset of this data is the Hadronic Physics Milestone for 2009. This cannot be met without significant investment now. Recognizing this, JLab has invested $250K in FY05 but in the present budget situation this cannot be continued without significant new funds from DOE. The resources for this project are estimated to be $3.8 M. We ask for an urgent positive response to the proposal for EBAC which was submitted last year.

IV. Initiatives – C. Lattice QCD

Success will mean that we have calculated the consequences of nonperturbative QCD with unprecedented accuracy in order to test its predictions against the precise new data provided by the 12 GeV Upgrade.

Lattice QCD currently provides our only means of solving QCD in the low-energy regime. Dr. Nathan Isgur recognized, in 1998, the crucial role that lattice QCD must play in hadronic and nuclear physics by founding, together with Prof. John Negele of MIT, the Lattice Hadron Physics Collaboration (LHPC). Subsequently, under the auspices of the Department of Energy's SciDAC initiative, the US theory community has developed the computational infrastructure to employ lattice QCD to solve a spectrum of problems in nuclear and particle physics. JLab (particularly Drs. R. Edwards and D. Richards of the Theory Center) plays a pivotal role in this SciDAC initiative and is now exploiting this role to address key questions across the JLab program.

The JLab Theory Center will continue to play central roles in the SciDAC initiative over the next four years with a focus on exploiting the technology to the world's most precise computations of hadron properties. A White Paper outlining the highest priority calculations which need to be made and the wonderful synergy between those calculations and the JLab program at 6 and 12 GeV was submitted to DOE earlier this year. This paper sets out the additional level of funding required between now and 2012 in order to optimize the physics output in relation to the 12 GeV Upgrade - essentially an additional $0.5m over current levels in FY07, increasing by $0.5m per year until FY12. It is essential that at least this level of Nuclear Physics funding for lattice QCD hardware be allocated in order to achieve this outstanding scientific opportunity. The resources required for the project over five years are estimated to be $12M.

An additional national advantage is that JLab will explore the limits of clusters of commercial computers for high performance computing. Already there are hints that this may be more cost effective than specialized machines such as QCDOC, but both must be explored.

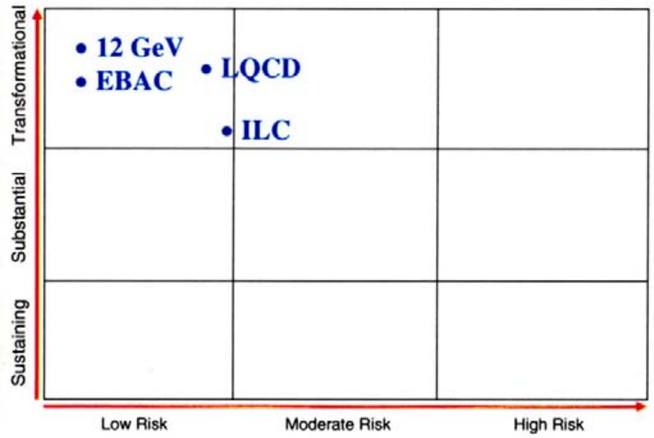
<u>IV. Initiatives – D. International Linear Collider (ILC)</u>

Since the announcement in 2004 of the technology choice for the International Linear Collider (ILC), Jefferson Lab has been actively engaged with the US and world scientific communities in preliminary discussions on the ILC project, and as members of ILC Working Groups. Lab management is working with the appointed ILC Global Design Effort (GDE) Director and the USILC GDE Director to develop a business plan for collaboration and participation of Jefferson Lab in ILC activities both on an immediate and long-term basis. Jefferson Lab's scientists and engineers will participate in and contribute to the Snowmass ILC workshop planned in August 2005.

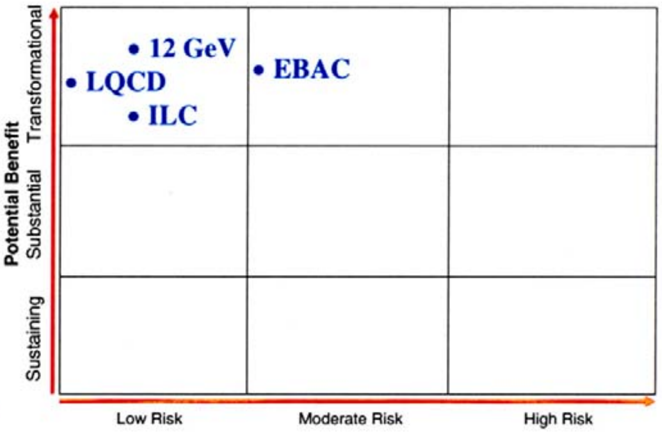
Jefferson Lab has submitted two Field Work Proposals to the DOE Office of Science's High Energy Physics (HEP) division in support of ILC – development of specific high gradient superconducting cavities and cryomodules, and preparations for industrialization of SRF technology in support of the ILC. This scope of work will substantively reduce the project's technical risks and costs and will be the hallmark of JLab's contributions to this challenging international project. Simultaneously, intense effort on high gradient and low-loss cavity R&D has already led to the ground-breaking large- and single-grain cavity fabrication and testing leading to the achievement of the highest gradient possible in niobium.

JLab has established a productive partnership with Fermilab (FNAL) relative to their Superconducting Module Test Facility (SMTF) initiative, supporting development and growth of an SRF infrastructure that will benefit FNAL as the primary HEP lab taking ILC responsibility at large. It is JLab's vision to remain an essential partner and collaborator and be the consolidator of SRF developments in support of the ILC, including the eventual industrialization of the technology. JLab plans to design and prototype a model-integrated cryomodule production plant suitable for technology transfer to US industry. Resources of $60M in capital investments and a staff addition of 20 FTE's are estimated.

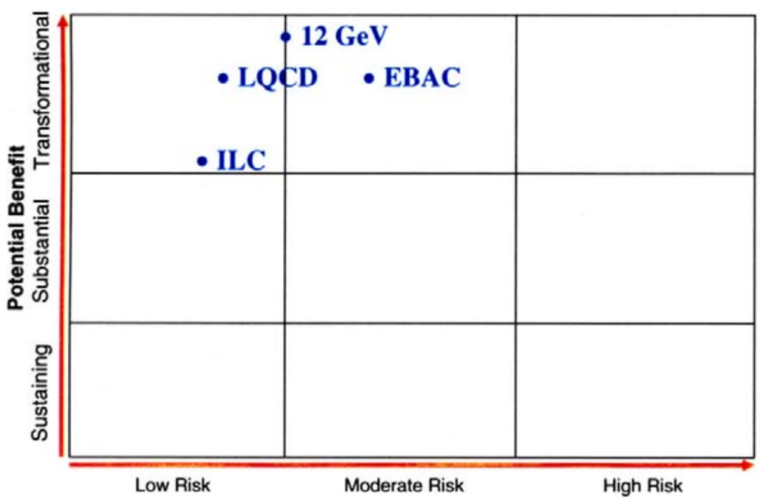
Map of Laboratory's Major R&D Initiatives
Market/Competition Risk v. Benefits



Map of Laboratory's Major R&D Initiatives
Technical Risk v. Benefits



Map of Laboratory's Major R&D Initiatives
Financial Management and Other Risk v. Benefits



V. Core Competencies – A. Nuclear Physics

Essential to carrying out JLab's mission in nuclear physics are the (i) existence at JLab of a unique research tool, the CEBAF accelerator, and the corporate knowledge required to operate it, and (ii), the competencies required to mount innovative experiments.

The accelerator provides simultaneously three experimental stations with beams of highest quality, polarization, and widely and independently adjustable parameters. It represents the world's largest operating SRF installation, largest 2 K cryogenic plant, and its over 200,000 control points are entirely computer controlled. A significant staff representing highly diverse and specialized skills is essential to maintain reliable operation.

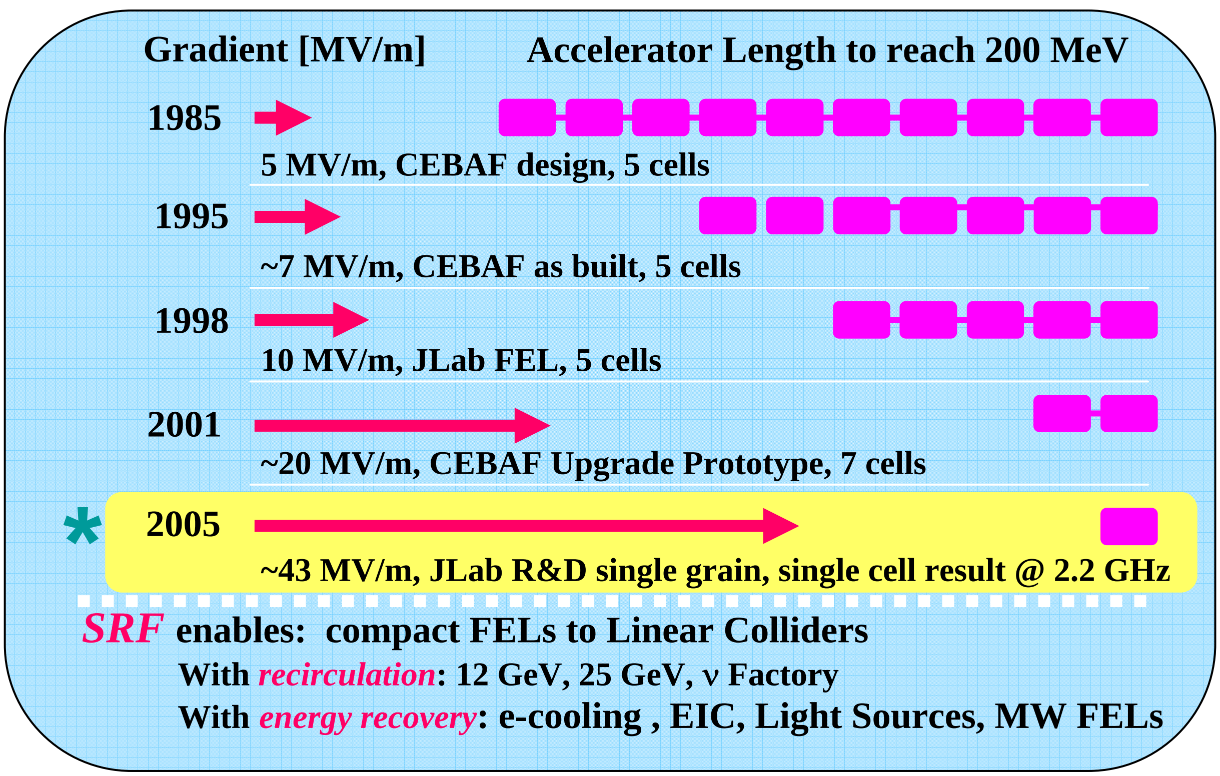
JLab's core competency in experimental nuclear physics includes the design, execution, and analysis of precision experiments involving studies of nucleons and nuclei by both electron scattering and photon-induced reactions.

This involves: state of the art simulations; the design, construction, and operation of super-conducting spectrometers, advanced detectors and electronics, and polarized and cryogenic targets; and the development and use of very high-rate data acquisition and very high-capacity data analysis systems. Our associated core competency in theoretical nuclear physics ranges from ab initio Lattice QCD calculations relevant to hadronic physics (including the design and development of multi-tera-flop/s scale computers) to reaction phenomenology essential to the extraction of physics results from experimental data.

V. Core Competencies – B. SRF and Related Accelerator Physics

The core competency in SRF comprises a multi-dimensional set of skills and sub-specialties of physics, metallurgy, materials science, and engineering, and its practice is inseparable from and dependent on an extensive technical infrastructure – at JLab representing a significant investment by the federal government. JLab expertise spans the whole spectrum from electromagnetic design to materials development to prototype development to full scale engineering, construction of project quantities, and most importantly, the long term operation of the world's largest existing SRF-based accelerator. With the construction of the original CEBAF, numerous incarnations of the FEL and its upgrades, several prototypes for the (now defunct) APT, RIA, and the 12 GeV Upgrade, as well as construction of the SNS, JLab has produced over 500 cavities, more than half the world's supply. Most recently, JLab demonstrated the promise of using single grain niobium to achieve a 45 MV/m cavity. The development of SRF at JLab is summarized below:

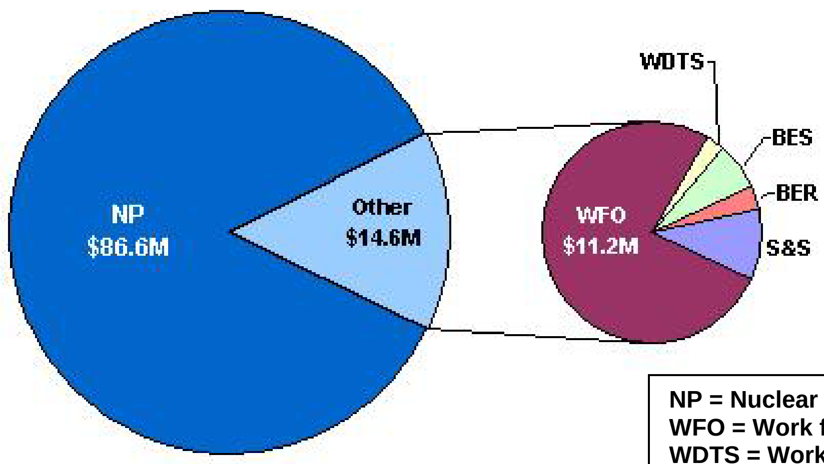
Advances in SRF, Combined with Beam Recirculation and Energy Recovery



As a consequence, and to make fullest use of the power efficiency of SRF driven accelerators, JLab has pioneered and advanced to operational maturity the concept of the energy-recovering linac (ERL), opening a path to MW FELs, light sources not limited in beam properties by conventional constraints, and electron-ion colliders of unprecedented luminosity.

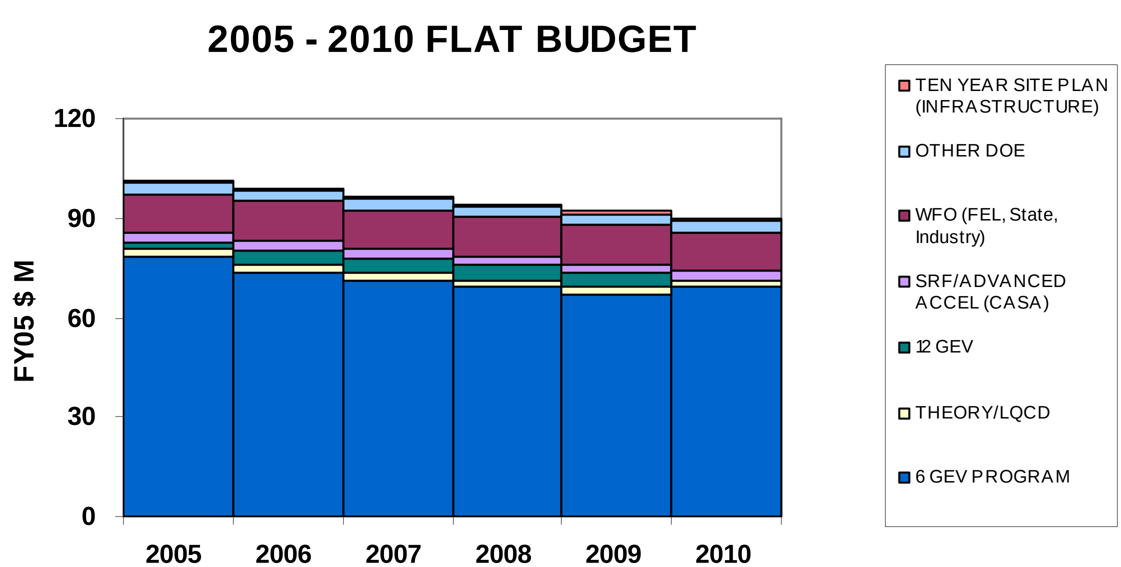
VI. Financial Outlook

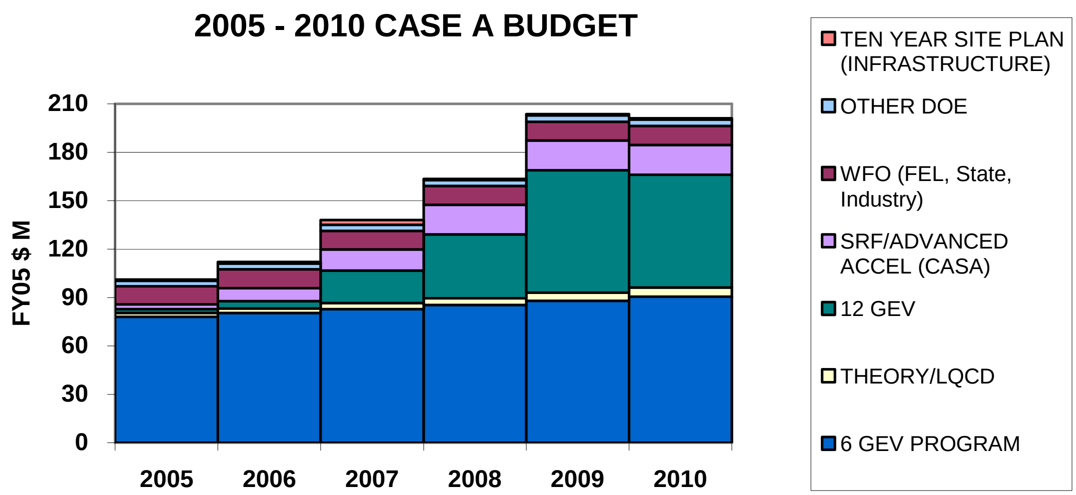
FY2005: Current
Total $101.2M



NP = Nuclear Physics
WFO = Work for Others
WDTS = Workforce Development for Teachers and Scientists
BES = Basic Energy Sciences
BER = Biological & Environmental Research
S&S = Safeguards & Security

MAJOR ASSUMPTION: In the Flat Budget Scenario, the investment in 12 GeV discontinues in FY2010 and physics output decreases by 30-40%

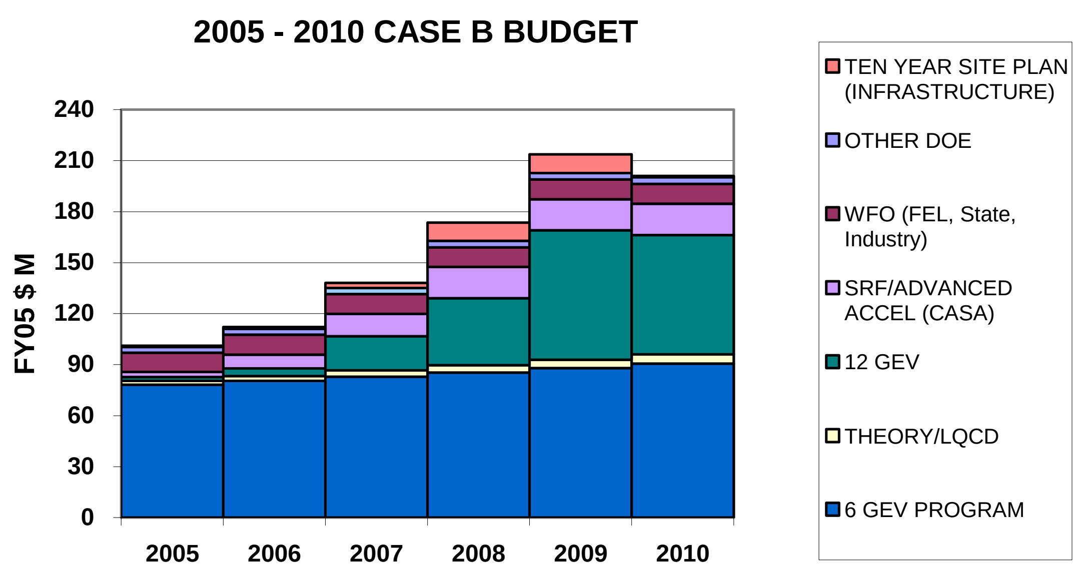




MAJOR ASSUMPTIONS:

CASE A ASSUMPTION:
INFLATION PLUS 12 GeV; Ten Year Site Plan without line item Construction Projects; HEP funding for SRF starting in FY2006

CASE B ASSUMPTION:
INFLATION PLUS 12 GeV; Ten Year Site Plan with line item Construction Projects; HEP funding for SRF starting in FY2006



VII. JLab in the Community – A. Science Education

Jefferson Lab has a strong record of helping DOE achieve its science education and workforce development goals. The Lab partners with the local community to enhance the quality of K-12 science and math education in the public schools. Jefferson Lab helps prepare the country's brightest students at the high school and undergraduate levels to become the next generation of scientists and engineers capable of solving complex problems of national importance.

The BEAMS (Becoming Enthusiastic About Math and Science) program, a national-model partnership with Newport News City Public Schools, supports inner-city students as they progress from the 6th to the 8th grades. Since 1991, BEAMS has been attended by nearly 20,000 students and 400 teachers. The BEAMS program, unique to Jefferson Lab, has positively influenced math and science standardized test scores for participating schools, closing the scoring gap between traditionally low scoring schools and average scoring schools. This science education program has helped the Lab build strong ties with the local community.

Jefferson Lab's High School Summer Honors Internship Program draws the region's highest achieving high school students. Jefferson Lab scientists transfer essential technical knowledge and enthusiasm for science to these young people at the critical time they begin to make career choices.

Undergraduate students interested in scientific and engineering fields are selected from a competitive, nationwide pool to work with scientists and engineers on projects related to Jefferson Lab's research program. Each year, the Science Undergraduate Laboratory Internship program prepares fifteen students to pursue science and technology careers of benefit to the nation.

Jefferson Lab offers its Teacher Academy in Physical Science program to K-12 teachers each summer. This four-week program for upper elementary and middle school teachers offers advanced scientific content and teaching methods in math and science. Jefferson Lab has been selected as one of seven national DOE laboratories to provide a DOE-sponsored teacher program. This is an extremely productive program that yields benefits to participants and the Department.

JLab's unique research environment and expertise in science, math, and technology create the basis for extraordinary educational opportunities that are solidly grounded in the Laboratory's scientific programs. These "pipeline" education programs are essential for providing a knowledgeable citizenry and the next generation of scientists and engineers critical for the nation's success.

VII. JLab in the Community – B. Scientific Community

Jefferson Lab, as an integral part of the national lab system, provides unique and complementary capabilities to the other labs in the system contributing to the Office of Science and DOE mission and to the overall national S&T agenda:

- Our internationally-based nuclear physics program complements the work being done at the other major US NP facility, RHIC, while enabling a program of hadronic physics research that is unique in the world to answer key questions about the structure of matter at its most fundamental (quark and gluon) level
- Our nuclear physics research program accounts for ¼ of all US Ph.D.s in the field
- Advanced computing initiatives (Lattice QCD, GRID,…) are interlaboratory collaborations that build on computing capabilities and expertise at the participating labs
- Our world-leading SRF and related advanced accelerator technologies provide essential expertise that has been and will continue to be utilized by other labs and disciplines within the Office of Science and beyond (Ex: SNS, 12 GeV Upgrade, RIA, ILC, JLab FEL)
- Our unique science and technology are advancing SC, DOE and national goals and objectives in other areas as well (Ex: medical imaging technology (BER and NIH))

- Tech transfer program will continue to be focused in areas where the Lab has unique core competencies to leverage synergy with our primary mission and we will continue to seek expert advice to guide those efforts (Ex: IAB for the FEL, MTAC for Defense, Imaging Review for Medical Imaging)
  - Program of support from Navy for FEL technology development
  - Realize potential for medical imaging
  - Partnership with EVMS for Laser Bioscience Center utilizing FEL
- JLab's Chief Scientist chairs a committee on international cooperation in nuclear physics which has been formed by the IUPAP committee C12.

VIII. Facility, Infrastructure and Maintenance

The majority of the current facility was constructed under the initial CEBAF project between 1987 and 1992, and has an average age of 14 years. The original facility to support a 4 GeV Program that now supports a thriving 6 GeV Program was built with inadequate user and limited technical support space. Due to the overwhelming success of the scientific program, demands on the infrastructure have steadily increased which exacerbates the original situation. In addition, there is insufficient technical support space that is not suited to the technical work being performed.

The cornerstone of our Ten Year Site Plan is a 61,000 square foot addition to CEBAF Center, currently under construction, that will provide an expanded computer center and offices allowing demolition of 22,000 square feet of existing trailer space. The maintenance backlog (deferred maintenance) will be substantially reduced with the demolition of trailers following construction of CEBAF Center Addition Phase 1. Deferred Maintenance reduction funding and other similar infusions of additional funding over the next five year period will continue to be used to reduce the maintenance backlog. With the projected target funding we will be challenged to meet the SC Facility Goals/Metric for a MII of at least 2% and the Goal/Metric of a reduction of deferred maintenance other than reduction from the elimination of trailers associated with the CEBAF Center Addition (CA) project and that funded by the special Deferred Maintenance Reduction funds.

Additional Key Facilities and Infrastructure issues continue to be primarily driven by the large number of personnel (over 130) who will remain housed in "temporary" trailers following completion of CEBAF Center Addition Phase 1. The plan proposes to address the programmatic needs for adequate technical support, experimental setup, and storage space by combining GPP and Deferred Maintenance Reduction funds to replace aging trailers with Technical Support Building 1, Technical Support Building 2, CEBAF Center Wing D, and various storage structures. This plan relies on JLab receiving an addition $2 million in GPP in FY07. JLab FY08 GPP funding is $770,000. A fallback position is to seek third party financing for at least a portion of the work.

Lab Space Distribution (Oct 2004)

GSA Use Code	Description	Owned – Gross SF				Leased – Gross SF	
		Building	**Real Property Trailers**	**Personal Property Trailers**	**OSF Category 3000**	**Building**	**Total SF**
10	Administration	66,277	41,901			79,081	187,259
20	School		1,327				1,327
40	Storage	25,810	660	21,744		11,558	59,772
50	Industrial Bldgs	7,235					7,235
60	Service Bldgs	4,373	3,518			2,904	10,795
70	Research & Development	303,118	1,940		192,792		497,850
80	Other	378					378
Total		407,191	49,346	21,744	192,792	93,543	764,616

Facility Condition Assessment (FY 2004)

Category	Deferred Maintenance (DM), $M	Facility Condition Index (FCI)	Rated Condition	Rehab & Improvement Cost (RIC), $M	Total Rehab & Improvement Cost (TRIC) $M
Buildings					
- DOE Owned	$3.20	3.67%	Good	$35.68	$38.88
- State Owned	$.41	5.50%	Adequate	$.03	$0.44
Real Property Trailers	$4.80	99.19%	Fail	$0	$4.80
Personal Property Trailers	$.55	96.1%	Fail	$0	$0.55
OSF – 3000 Category	$.29	0.3%	Excellent	$.27	$0.56
OSF – Non 3000 Category (Utilities, Roads, etc.)	$1.31	7.32%	Adequate	$7.42	$8.73
Total (DOE Buildings, real property trailers, & Non-3000 OSF	$9.31	8.47%	Adequate	$43.1	$52.41

IX. Management – A. Personnel

The success of Jefferson Lab's scientific program is anchored by the leadership of its key managers and depends on its ability to attract and retain a diverse world-class workforce.

The Laboratory maintains an international recruiting program utilizing targeted advertising, professional conferences, collaborative working arrangements, scientific and technical journals, and university contacts as a means of identifying potential candidates for key positions. This is a necessary component of our manpower planning as Jefferson Lab is a relative small laboratory with many one-of-a-kind positions. This creates staffing challenges of recruiting, selecting and retaining individuals with highly specialized scientific, technical and managerial skills.

As of September 30, 2004, the SURA/Jefferson Lab workforce was comprised of 617 employees plus 11 Commonwealth of Virginia employees.

Distribution of skills in organization:

Scientists & Engineers	44%
Technicians	33%
Administration	20%
Skilled Workers	3%

Below are the staffing plan numbers for FY05-FY11.

Jefferson Lab Personnel Summary

Assumption: inflation @ 3% plus full 12 GeV project funding
Plus HEP funding for SRF starting in FY2006
(Reference Financial Slides Case A)

Full-Time Equivalent (FTE)	FY2005	FY2006	FY2007	FY2008	FY2009	FY2010	FY2011
Nuclear Physics	462	462	462	462	462	462	462
12 GeV	10	20	60	100	150	175	150
Other Office of Science	28	23	35	40	40	40	40
WFO	67	72	72	72	72	72	72
Indirect	137	138	157	162	162	162	162
TOTAL LAB PERSONNEL	**704**	**715**	**786**	**836**	**886**	**911**	**886**

Includes all full-time staff, part-time staff, contract labor and joint/bridged positions

Jefferson Lab utilizes a comprehensive staffing plan that identifies, prioritizes and projects programmatic labor needs. Through careful monitoring of hiring and attrition our workforce trending in the out years demonstrates constant effort in the indirect functions. Programmatic needs point to an increase labor as the 12 GeV project progresses through each critical decision award phase.

IX. Management – B. Operational Issues – Security, Cyber Security, and Safety

Security

The '03 and '04 Design Basis Threat (DBT) identifies threats; capabilities of adversaries, what needs to be protected, and lists possible protective strategies. The 2004 DBT merged levels IV and V, and JLab remains at the lowest level. JLab '04 Site Security Plan identifies JLab's graded protection strategies - approved by DOE.

Impacts of security requirements
Update DOE directives on Foreign Visits and Assignments, counterintelligence, and sensitive information and incorporate into Lab documentation and processes. Largest impact likely from meeting requirements of HSPD-12 (Personnel Identity Verification). Significant cost impact to Lab if this is implemented without "graded approach."

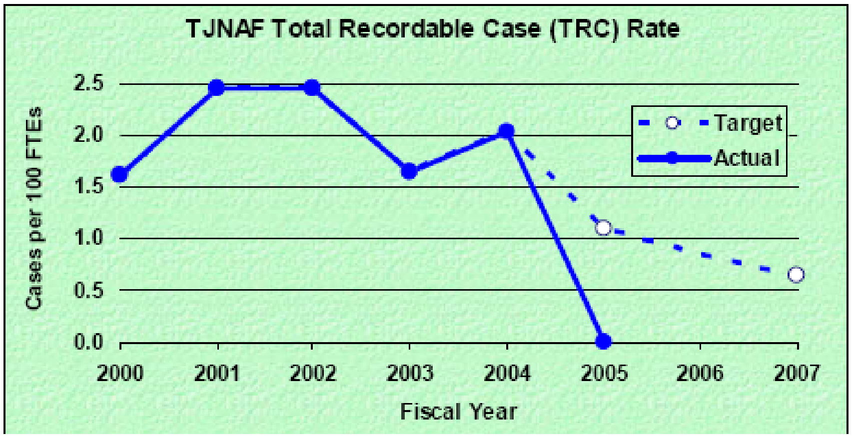
Cyber Security
JLab is moving aggressively in the area of cyber security. As planned, the Lab's cyber security program has been certified under the new Office of Science Program Cyber Security Plan, and the Lab anticipates accreditation by July 1.

The Lab achieved significant improvements in the cyber security program over the last year, some of which can be attributed to addressing vulnerabilities identified by the OA Cyber Security Review (May 2004). While resources are tight, the Plans Of Action and Milestones are being met, and the May 2005 Cyber Security Peer Review rated the Lab's cyber security program as "Outstanding."

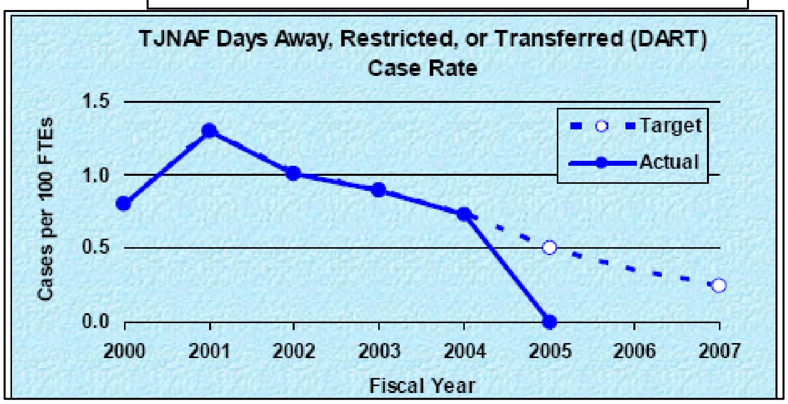
Safety Improvement at Jefferson Lab
Jefferson Lab is moving aggressively to improve its safety performance through a multi-activity initiative. JLab's new safety challenge focus is "Accidents are preventable, zero injuries are our goal." JLab began in 2004 analyzing its safety performance with the help of an expert outside contractor and initiated the following action items:

- Instituted organization changes including the addition of the Associate Director of Safety reporting to the Laboratory Director and a member of the senior management team
- Articulated the safety challenge at all levels of the organization
- Chartered integrated teams to improve electrical safety and material handling
- Conducted a safety culture survey to baseline and guide safety initiatives
- Emphasized timely reporting of minor injuries/incidents
- Developed and rolled out a comprehensive safety strategy
- Established a Worker Safety Committee for routine floor level feedback

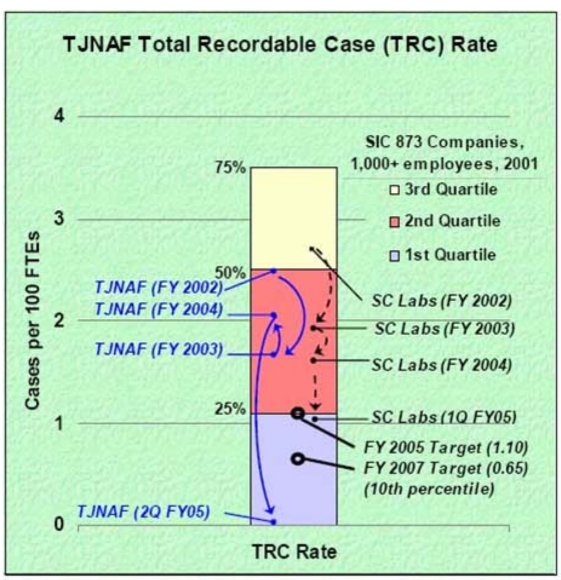
A review of current lagging indicators (Total Recordable Case (TRC) Rate and Days Away/Restricted/Transferred (DART) Rate) show significant improvement and compare well with results at other SC labs. JLab has now logged over 1 million hours without a lost workday away injury. For this improved performance, JLab credits its multi-pronged approach and its capability to convince an increasing number of Lab employees that management has a genuine concern for their safety and well-being.

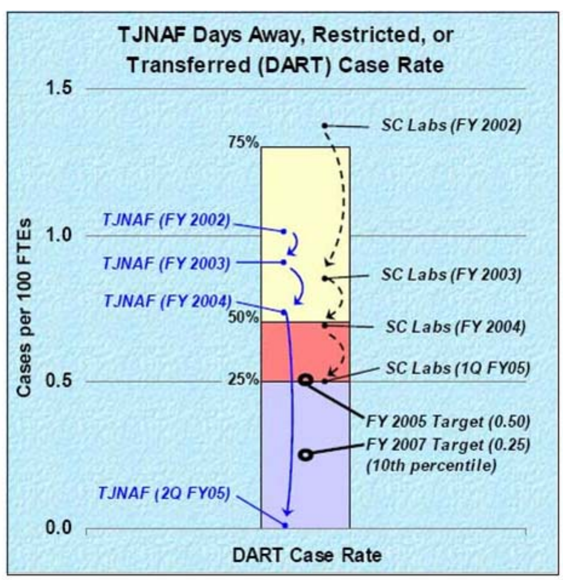


Actual rate for 2005 is through first two quarters only



Actual rate for 2005 is through first two quarters only





To maintain continuous improvement well in to the future JLab plans the following activities:

- Upgrading lab wide issues tracking, trending, and analysis
- Refocusing self-assessment programs on work management and Environment, Health and Safety
- Assessing Integrated Safety Management effectiveness

- Developing meaningful leading indicators
- Improving laboratory wide lessons learned/good practices to spur further improvement
- Continuing to share information with other SC and commercial laboratories through a multitude of venues

X. Summary

JLab defines success as its capability to maintain a position as a vibrant scientific center leading the world in all its core competencies

The specific content of this statement implies:

> First, to build the 12 GeV Upgrade on the fastest possible track, ideally for a beginning of physics by 2012. The importance of the 12 GeV Upgrade is such that it remains the highest priority even if funding realities should dictate a slower pace and temporary curtailment of the ongoing research program.
>
> Second, to deliver outstanding experimental results from the ongoing strong QCD program, ideally at 70% or better of full capacity although the Lab is ready to adapt to reduced operation for the sake of the 12 GeV Upgrade.
>
> Third, to establish a firm position as world leader and R&D provider of choice for superconducting microwave technology and the science and technology of ERLs.
>
> Fourth, to realize the full potential of other core competencies: develop applications and scientific use of FELs beyond the 1 MW, 1 μm naval use, covering the spectrum from the DUV to the THz range.

We consider the following to be critical factors for achieving success:

> First, convince decision makers that Nuclear Physics is making an important contribution to the nation, deserving a commensurate funding profile.
>
> Second, to deliver on the commitments implicit in its programs and projects, JLab's must maximize the return on funding through judicious choices, and best operations and business practices.
>
> Beyond the - at most moderate – scientific/ technical risks identified earlier, JLab considers two major risks. First, the possibility that it might prove impossible to reverse the tide of reduced funding of Nuclear (and possibly High Energy) Physics would certainly invalidate our projections and planning on the five-year time horizon. Second, it is far from clear that JLab will succeed in overcoming hurdles to achieve and benefit from a broad, scientific application and use of the FEL.

To assure priority needs are met, JLab relies on a number of plans and processes to minimize risk and optimize critical success factors. They include a compelling vision, well communicated, a commitment to best practices further supported and enhanced by the contractor, and special safeguards to assess performance.

JLab bases its efforts to project and communicate its role within the Office of Science laboratory system on a compelling vision aligned with the DOE/SC mission and national needs that stresses JLab's salient features of uniqueness, restraint and sharp focus, products and services not available elsewhere, and a solid commitment to be a world leader in our mission areas.

Thus, the JLab nuclear physics program provides irreducible, essential building blocks of the "intellectual edifice" that explains the world, and the accelerator technology expertise that no other US lab can provide and that is second to none worldwide. All initiatives planned in this business plan are grounded in existing core competencies, in which JLab can claim world leadership.

JLab considers communication essential to a broad range of audiences including other scientists, decision makers, and the general public at several levels, utilizing a matching broad set of channels and communication vehicles, from print to internet to highly popular open house events.

JLab works intensely with the community and decision makers to secure SC/NP funding necessary to achieve our vision, and continues to mobilize and organize its user community to develop interest in the program and communicate achievements and exceptional performance.

The Lab's ability to deliver on its commitments is closely linked to its ability to maximize return on funding. It will rest on continued emphasis on professional excellence, leverage and build on our unique core competencies, evaluate program content and execution through peer and customer review, and re-engineer the JLab organization and its work processes.

The Lab aims for significant cost savings to maximize resources for science while minimizing operational risks, and best business practices in all operational aspects. Work will be uniformly defined, controlled, and costed based on Work Breakdown Structure (WBS), enabling activity-based cost accounting, and work processes will be systematically reviewed and, where necessary, streamlined. Lab leadership is particularly committed to the highest standards in ES&H, the stewardship of the facility, and cultivating the engineering profession.

The laboratory can count on the contractor's contribution in numerous ways: third party financing where appropriate and advantageous, professorships as enticement for the hire of exceptional staff, the involvement and active interest of researchers based in academe, and the relations building skills of the Presidents of SURA's sixty-seven member Universities. Looking forward, SURA is partnering with an industrial entity that will bring to bear invaluable expertise and help in JLab's effort to optimize its organization and work processes.

With regards to help needed or desirable from the DOE, the foremost is some sense of funding stability, followed by a light touch and graded approach in implementing security measures at unclassified labs, and strong advocacy for the admission of foreign collaborators, particularly those who have made significant material contributions.